IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

WSOU INVESTMENTS, LLC d/b/a BRAZOS LICENSING AND DEVELOPMENT, Plaintiff, v. DELL TECHNOLOGIES INC., DELL INC., EMC CORPORATION, AND VMWARE, INC. Defendants.	§ § § § § § § § § § § §	CIVIL ACTION NO. 6:20-cv-486 **JURY TRIAL DEMANDED**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff WSOU Investments, LLC d/b/a Brazos Licensing and Development ("Brazos" or "Plaintiff"), by and through its attorneys, files this Complaint for Patent Infringement against Dell Technologies Inc., Dell Inc., EMC Corporation, and VMWare, Inc. (collectively, "Defendants") and alleges:

NATURE OF THE ACTION

1. This is a civil action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. §§ 1, et seq., including §§ 271, 281, 284, and 285.

THE PARTIES

2. Brazos is a limited liability corporation organized and existing under the laws of Delaware, with its principal place of business at 605 Austin Avenue, Suite 6, Waco, Texas 76701.

3. On information and belief, defendant Dell Technologies Inc. ("Dell") is a Delaware corporation with a principal place of business at One Dell Way, Round Rock, Texas 78682.

4. On information and belief, defendant Dell Inc. is a Delaware corporation with a principal place of business at One Dell Way, Round Rock, Texas 78682. Dell Inc. is wholly owned by its corporate parent, Dell.

5. On information and belief, defendant EMC Corporation ("EMC") is a Massachusetts corporation with a principal place of business at One Dell Way, Round Rock, Texas 78682. EMC Corporation is wholly owned by its corporate parent, Dell Technologies Inc.

6. Upon information and belief, VMware, Inc. ("VMWare") is a Delaware corporation with two established places of business in this District, including two in Austin, Texas with over 700 employees.

7. Upon information and belief, VMWare was acquired by EMC in 2004 and conducted an initial public offering of Class A common stock in August 2007. On or around September 2016, Dell acquired by EMC. As a result, EMC became a wholly-owned subsidiary of Dell, and VMWare became an indirectly-held, majority-owned subsidiary of Dell. Under the rules of the New York Stock Exchange, VMWare is a controlled company. As of January 31, 2020, Dell controlled approximately 80.9% of VMWare's outstanding common stock, including 31 million shares of its Class A common stock and all of it Class B common stock.

JURISDICTION AND VENUE

8. This is an action for patent infringement which arises under the Patent Laws of the United States, in particular, 35 U.S.C. §§ 271, 281, 284, and 285.

9. This Court has jurisdiction over the subject matter of this action under 28 U.S.C. §§ 1331 and 1338(a).

10. This Court has specific and general personal jurisdiction over each defendant pursuant to due process and/or the Texas Long Arm Statute, because each defendant has committed

acts giving rise to this action within Texas and within this judicial district. The Court's exercise of jurisdiction over each defendant would not offend traditional notions of fair play and substantial justice because each defendant has established minimum contacts with the forum. For example, on information and belief, each defendant has committed acts of infringement in this judicial district, by among other things, selling and offering for sale products that infringe the asserted patent, directly or through intermediaries, as alleged herein.

11. Venue in the Western District of Texas is proper pursuant to 28 U.S.C. §§1391 and/or 1400(b). Each defendant has established places of business in the Western District of Texas. Each defendant is registered to do business in Texas. Upon information and belief, each defendant has transacted business in this District and has committed acts of infringement in this District.

COUNT ONE - INFRINGEMENT OF U.S. PATENT NO. 7,092,360

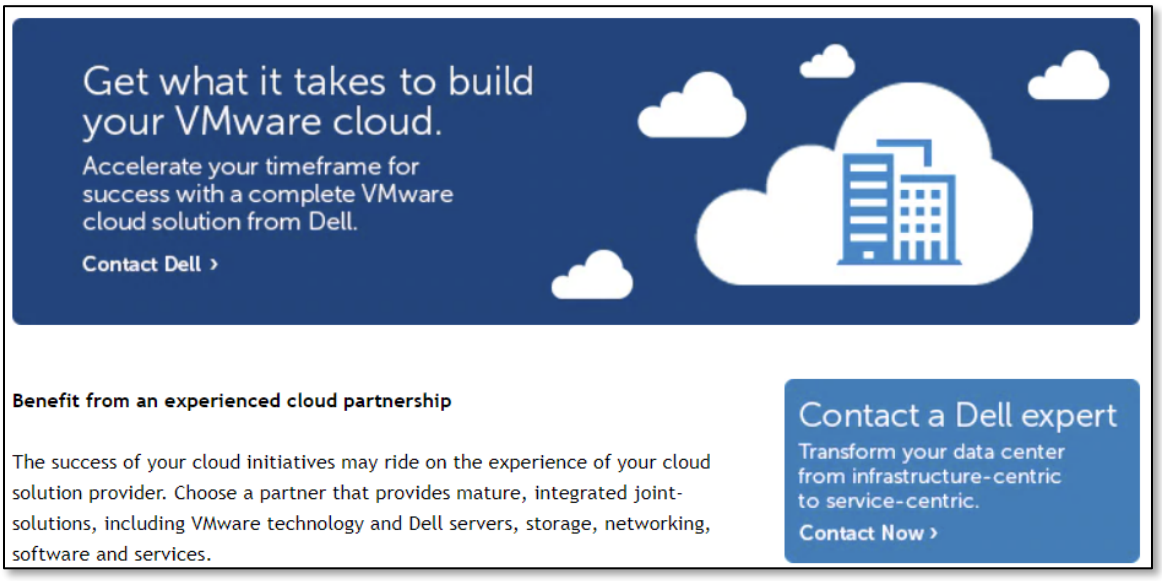
12. Brazos re-alleges and incorporates by reference the preceding paragraphs of this Complaint.

13. On August 15, 2006, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 7,092,360 ("the '360 Patent"), entitled "Monitor, System and Method for Monitoring Performance of a Scheduler." A true and correct copy of the '360 Patent is attached as Exhibit A to this Complaint.

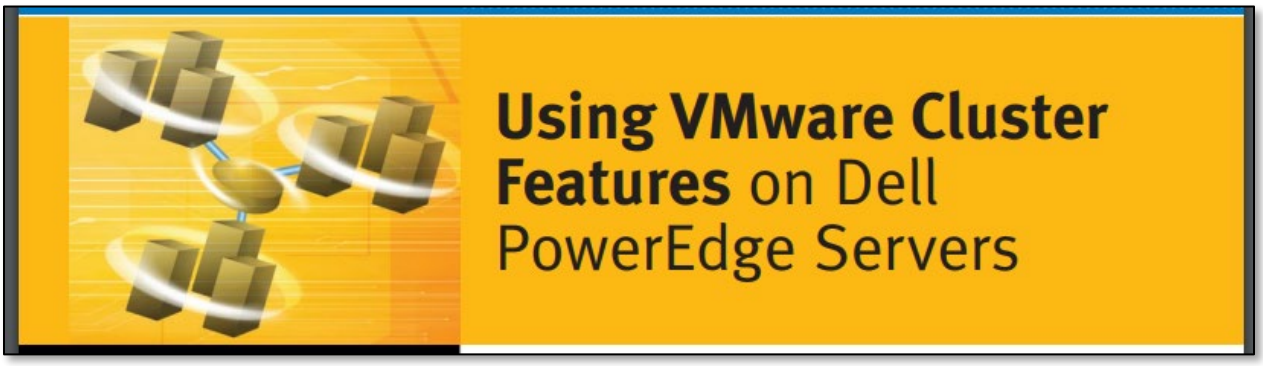
14. Brazos is the owner of all rights, title, and interest in and to the '360 Patent, including the right to assert all causes of action arising under the '360 Patent and the right to any remedies for the infringement of the '360 Patent.

15. Defendants make, use, sell, offer for sale, import, and/or distribute in the United States, including within this judicial district, products such as, but not limited to, cloud-related solutions, including but not limited to, devices incorporating VMware's VeloCloud solutions and

vSphere software, such as Dell's PowerEdge servers and VxRail appliances (collectively, the "Accused Products").



https://www.dell.com/learn/us/en/15/solutions/vmware-vcloud



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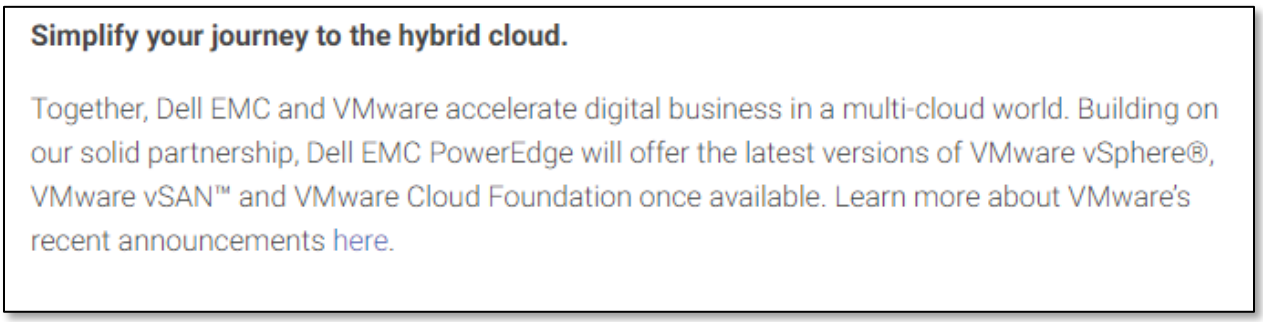


https://www.delltechnologies.com/en-us/solutions/vmware/servers-for-vmware.htm

> The two-socket server is an ideal base for building VI3 clusters as there are not as many "eggs in one basket". However, it would be best if there were a mechanism to restart the virtual machines from the failed hosts on remaining hosts in the VMware farm. Using VMware's HA (High Availability) and DRS (Distributed Resource Scheduler) it is possible to obtain this functionality.
>
> VMware HA allows virtual machines on failed ESX server hosts to restart on surviving ESX hosts. The DRS solution uses system algorithms and user created rules to determine the optimal placement of the virtual machines.

https://www.dell.com/downloads/global/vectors/dell_and_vmware_drs_ha_solutions.pdf

3 VxRail appliances

VxRail is jointly developed by Dell EMC and VMware and is the only fully integrated, preconfigured, and tested HCI appliance that is powered by VMware Virtual SAN (vSAN). VxRail is managed through the vCenter Server interface. It provides a familiar vSphere experience and enables streamlined deployment and the ability to extend the use of existing IT tools and processes.

VxRail appliances are managed using VxRail HCI System software for hardware and appliance maintenance tasks as well as software life cycle management. VxRail HCI System Software incorporates Secure Remote Services (SRS) and other serviceability capabilities. VxRail appliances are discoverable and visible in Dell EMC Vision™ Intelligent Operations.

Note: For day-to-day VM management, you manage the VMware stack on the VxRail appliance directly through vCenter server.

The VxRail software bundle is preloaded and licensed onto hardware and consists of the following components (specific software versions not shown):

- VxRail HCI System Software
- VMware vCenter Server
- VMware vRealize Log Insight™
- VMware vSAN™
- Dell Secure Remote Services (SRS)/VE

Also preloaded is VMware vSphere®; however, licenses are required and can be purchased through Dell EMC, VMware, or your preferred VMware reseller partner.

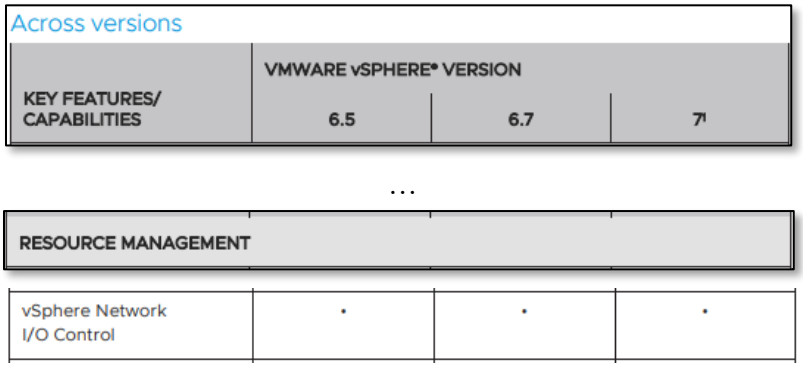
https://www.dellemc.com/resources/en-us/asset/technical-guides-support-information/products/converged-infrastructure/vxrail-vcenter-server-planning-guide.pdf

16. The Accused Products provide functions for resource management, designated as Network I/O Control (NetIOC), including scheduling.

Performance Evaluation of Network I/O Control in VMware vSphere® 6

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf

VMware vSphere Feature Comparison



https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/products/vsphere/vmware-vsphere-feature-comparison-datasheet.pdf

Performance Best Practices for VMware vSphere 6.7

Network I/O Control (NetIOC)

For further information about NetIOC, see *Performance Evaluation of Network I/O Control in VMware vSphere 6.0* and *vSphere Networking* for version 6.7.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/performance/vsphere-esxi-vcenter-server-67-performance-best-practices.pdf

NetIOC introduces an additional layer of packet scheduling at the hypervisor. A major enhancement in NetIOC in vSphere 6.0 with respect to previous NetIOC releases is that a separate scheduler queue is maintained for each virtual port. The network scheduler picks up packets from the network port queues and dispatches them for transmit over the network adapter, while making sure that bandwidth, shares, and limit settings are provided to each network port in NetIOC.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf

17. In NetIOC, each resource-pool flow can have a dedicated software queue inside the scheduler.

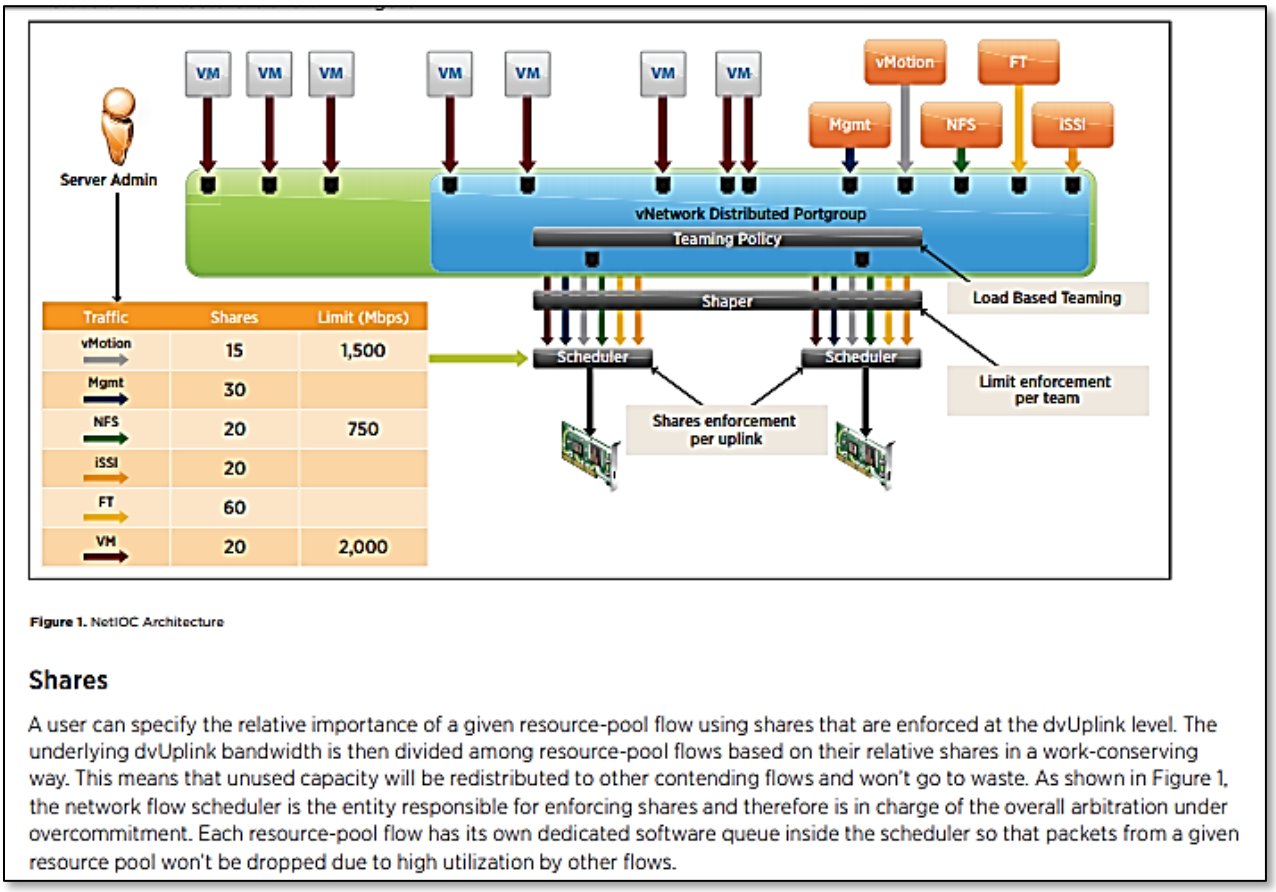


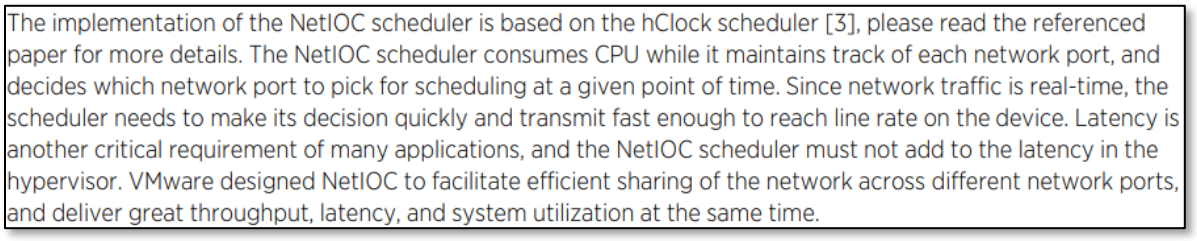
Figure 1. NetIOC Architecture

Shares

A user can specify the relative importance of a given resource-pool flow using shares that are enforced at the dvUplink level. The underlying dvUplink bandwidth is then divided among resource-pool flows based on their relative shares in a work-conserving way. This means that unused capacity will be redistributed to other contending flows and won't go to waste. As shown in Figure 1, the network flow scheduler is the entity responsible for enforcing shares and therefore is in charge of the overall arbitration under overcommitment. Each resource-pool flow has its own dedicated software queue inside the scheduler so that packets from a given resource pool won't be dropped due to high utilization by other flows.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/vmware_netioc_bestpractices-white-paper.pdf

18. The NetIOC scheduler in the Accused Products tracks each network port and decides which network port to pick for scheduling the dispatch of data traffic. The NetIOC scheduler is based on the hClock Scheduler.


The implementation of the NetIOC scheduler is based on the hClock scheduler [3], please read the referenced paper for more details. The NetIOC scheduler consumes CPU while it maintains track of each network port, and decides which network port to pick for scheduling at a given point of time. Since network traffic is real-time, the scheduler needs to make its decision quickly and transmit fast enough to reach line rate on the device. Latency is another critical requirement of many applications, and the NetIOC scheduler must not add to the latency in the hypervisor. VMware designed NetIOC to facilitate efficient sharing of the network across different network ports, and deliver great throughput, latency, and system utilization at the same time.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf

19. Various tags are in use in the hClock scheduler to help in monitoring the status of different states of an element in hClock Scheduler. For example, Reservation tags (Rq), Limit tags (Lq) and Shares tags (Sq) are used to track the allocation based on reservation values (rq), limit values (lq), and shares values (sq) respectively, and these elements track different metrics associated with a transmit queue. These tags are in a real-time domain to track the fulfillment of reservations and limits by comparing the corresponding tags with the real-time values. Comparison is made regarding the previous values and the real-time value, which helps in determining the output.

> We first present a brief outline of mClock algorithm that supports the same three controls per queue in a non-hierarchical manner. mClock uses three separate tags per queue q. These tags namely, reservation tag (R_q), limit tag (L_q) and shares tag (S_q) are used to track the allocation based on reservation value (r_q), limit value (l_q) and shares value (s_q) respectively. These tags are incremented based on corresponding r, l and s values whenever each IO is scheduled. All of these tags are in real time domain to track the fulfillment of reservations and limits by comparing the corresponding tags with the real time.

…

Symbol	Meaning
T	Current real time
q	A queue regardless of its type
s_q	Shares of queue q
r_q	Reservation setting of queue q
l_q	Limit setting of queue q
S_q	Proportional shares tag of queue q
R_q	Reservation tag of queue q
L_q	Limit tag of queue q
K, M, G	10^3, 10^6 and 10^9

Table 2. Symbols used and their descriptions

https://dl.acm.org/doi/abs/10.1145/2465351.2465382

20. The hClock scheduler checks the status of each queue. There are pointers associated at the end of each queue to track the status. The next step is based on the output of the status of the queue.

> When a new request arrives in a queue q, we first check the activity status. If the queue is already active, the request is simply added to the end of the queue. The more interesting case is when q is idle. If so, we need to activate the queue which allows it to be considered during next scheduling instance.

https://dl.acm.org/doi/abs/10.1145/2465351.2465382

21. The Accused Products are programmed to handle transmit queues.

NetIOC's scheduling algorithm adds an additional scheduling layer which slices the NIC bandwidth to meet the NetIOC reservation, limit, and share policies. Packets may queue up at the network port when the NIC transmit queue is being programmed by NetIOC. This might lead to a slightly higher wait time for a packet.

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NetIOC Architecture

The overall architecture is shown in Figure 1.

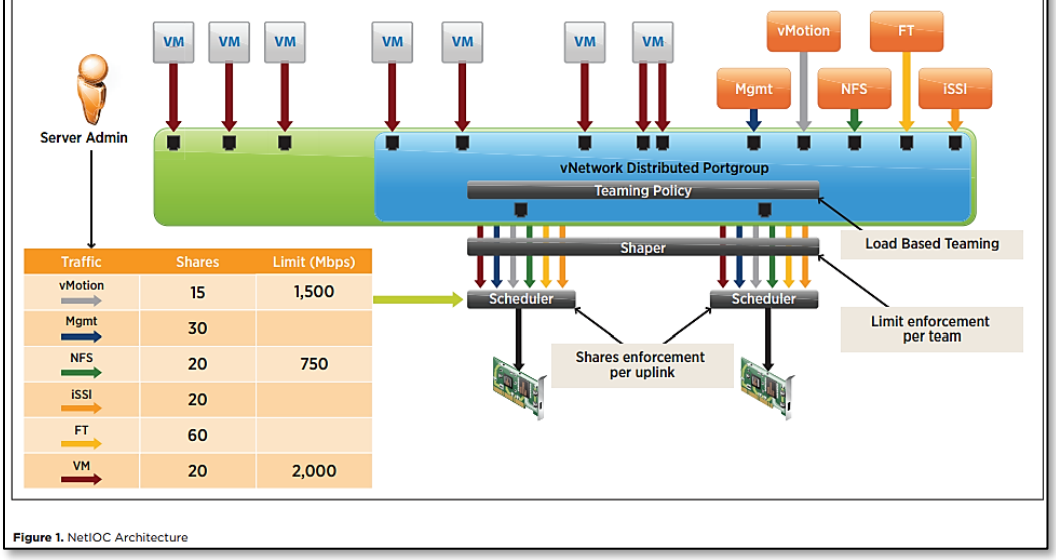

Figure 1. NetIOC Architecture

Shares

A user can specify the relative importance of a given resource-pool flow using shares that are enforced at the dvUplink level. The underlying dvUplink bandwidth is then divided among resource-pool flows based on their relative shares in a work-conserving way. This means that unused capacity will be redistributed to other contending flows and won't go to waste. As shown in Figure 1, the network flow scheduler is the entity responsible for enforcing shares and therefore is in charge of the overall arbitration under overcommitment. Each resource-pool flow has its own dedicated software queue inside the scheduler so that packets from a given resource pool won't be dropped due to high utilization by other flows.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/vmware_netioc_bestpractices-white-paper.pdf

22. The Accused Products provide the impact of NetIOC Scheduler on a vSphere host and have a separate scheduler queue for each virtual port. The NetIOC scheduler picks up packets from the network port queues. It dispatches them for transmitting over the network adapter while making sure that bandwidth, shares, and limit settings are provided to each

network port in NetIOC.

> NetIOC introduces an additional layer of packet scheduling at the hypervisor. A major enhancement in NetIOC in vSphere 6.0 with respect to previous NetIOC releases is that a separate scheduler queue is maintained for each virtual port. The network scheduler picks up packets from the network port queues and dispatches them for transmit over the network adapter, while making sure that bandwidth, shares, and limit settings are provided to each network port in NetIOC.

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23. As noted above, the NetIOC scheduler decides which network port to pick for scheduling at a given amount of time among the plurality of ports and queues. It can use one transmit queue of a port from the available ports.

> The implementation of the NetIOC scheduler is based on the hClock scheduler [3], please read the referenced paper for more details. The NetIOC scheduler consumes CPU while it maintains track of each network port, and decides which network port to pick for scheduling at a given point of time. Since network traffic is real-time, the scheduler needs to make its decision quickly and transmit fast enough to reach line rate on the device. Latency is another critical requirement of many applications, and the NetIOC scheduler must not add to the latency in the hypervisor. VMware designed NetIOC to facilitate efficient sharing of the network across different network ports, and deliver great throughput, latency, and system utilization at the same time.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf

> The current implementation of NetIOC is limited to using one transmit DMA channel (transmit queue) of the NIC. This is necessary to impose the constraints of bandwidth reservations. On the other hand, the default

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf

24. The Accused Products may also use HClock Multiqueue to distribute traffic across multiple transmit queues on a single physical NIC.

> **Network I/O Control Advanced Performance Options**
>
> - A new option in vSphere 6.5, HClock Multiqueue, can improve performance in some environments with small packets and high packet rate. This option, which is disabled by default, allows multiple vNICs or multiple vmknics to distribute traffic across multiple hardware transmit queues on a single physical NIC.

https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/performance/Perf_Best_Practices_vSphere65.pdf

25. The hClock scheduler in the Accused Products has an algorithm based on whether a transmit queue is empty or occupied.

Algorithm 4: Queue Eligibility

FindEligibleQueue ()
  let E be the set of queues with R_q and $L_q \leq T$
  if E *is not empty* **then**
    let q be the queue with the minimum R_q
    flag q and ancestors as eligible for reservation
  else
    let q be the $root$ of the hierarchy
  return FindEligibleQueueBasedOnShares(q)

FindEligibleQueueBasedOnShares (queue q)
  if q *is a leaf* **then**
    return q
  let E_c be the set of q's children, whose limit tag $\leq T$
  if E_c *is empty* **then**
    return nil
  let c be the child queue of q with minimum S_c
  return FindEligibleQueueBasedOnShares(c)

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26. Various decisions for a scheduler in the Accused Products are based on the number of packets in a queue, which is calculated based on "packet length."

Algorithm 3: Scheduling Process

let $max\_inflight$ = maximum allowed outstanding bytes
let $inflight$ be the current outstanding bytes

ScheduleRequest ()
  while $inflight \leq max\_inflight$ **do**
    q = FindEligibleQueue()
    p = DeQueuePacket(q)
    $inflight$ += $packetLength$ of p
    send p to the device for transmit

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27. In view of preceding paragraphs, each and every element of at least claim 26 of the '360 Patent is found in the Accused Products.

28. Defendants continue to directly infringe at least one claim of the '360 Patent, literally or under the doctrine of equivalents, by making, using, selling, offering for sale, importing, and/or distributing the Accused Products in the United States, including within this judicial district, without the authority of Brazos.

29. Defendants have received notice and actual or constructive knowledge of the '360 Patent since at least the date of service of this Complaint.

30. Since at least the date of service of this Complaint, through its actions, Defendants have actively induced product makers, distributors, retailers, and/or end users of the Accused Products to infringe the '360 Patent throughout the United States, including within this judicial district, by, among other things, advertising and promoting the use of the Accused Products in various websites, including providing and disseminating product descriptions, operating manuals, and other instructions on how to implement and configure the Accused Products. Examples of such advertising, promoting, and/or instructing include the documents at:

- https://www.dell.com/learn/us/en/15/solutions/vmware-vcloud
- https://www.dell.com/downloads/global/power/ps3q07-20070562-hanson.pdf
- https://www.delltechnologies.com/en-us/solutions/vmware/servers-for-vmware.htm
- https://www.dell.com/downloads/global/vectors/dell_and_vmware_drs_ha_solutions.pdf
- https://www.dellemc.com/resources/en-us/asset/technical-guides-support-information/products/converged-infrastructure/vxrail-vcenter-server-planning-guide.pdf
- https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/network-ioc-vsphere6-performance-evaluation-white-paper.pdf
- http://fileapi.it.hactcm.edu.cn/yjsyxnh/file/2019/3/1/131959260611073796.pdf

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- https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/products/vsphere/vmware-vsphere-feature-comparison-datasheet.pdf
- https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/performance/vsphere-esxi-vcenter-server-67-performance-best-practices.pdf

31. Since at least the date of service of this Complaint, through its actions, Defendants have contributed to the infringement of the '360 Patent by having others sell, offer for sale, or use the Accused Products throughout the United States, including within this judicial district, with knowledge that the Accused Products infringe the '360 Patent. The Accused Products are especially made or adapted for infringing the '360 Patent and have no substantial non-infringing use. For example, in view of the preceding paragraphs, the Accused Products contain functionality which is material to at least one claim of the '360 Patent.

JURY DEMAND

Brazos hereby demands a jury on all issues so triable.

REQUEST FOR RELIEF

WHEREFORE, Brazos respectfully requests that the Court:

(A) Enter judgment that Defendants infringe one or more claims of the '360 Patent literally and/or under the doctrine of equivalents;

(B) Enter judgment that Defendants have induced infringement and continue to induce infringement of one or more claims of the '360 Patent;

(C) Enter judgment that Defendants have contributed to and continue to contribute to the infringement of one or more claims of the '360 Patent;

(D) Award Brazos damages, to be paid by Defendants in an amount adequate to compensate Brazos for such damages, together with pre-judgment and post-judgment interest for the infringement by Defendants of the '360 Patent through the date such judgment is entered in accordance with 35 U.S.C. § 284, and increase such award by up to three times the amount found or assessed in accordance with 35 U.S.C. § 284;

(E) Declare this case exceptional pursuant to 35 U.S.C. § 285; and

(F) Award Brazos its costs, disbursements, attorneys' fees, and such further and additional relief as is deemed appropriate by this Court.

Dated: June 2, 2020

Respectfully submitted,

/s/ James L. Etheridge

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